FEB 05 2004

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of:	)	Before the Examiner
	)	
Anthony Billington	)	Not Yet Assigned
	)	
Serial No. 10/691,093	)	Group Art Unit 3746
	)	
Filed October 22, 2003	)	
	)	Our Ref.: 27049-7
COMPRESSOR WHEEL ASSEMBLY	)	

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February 2, 2004
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John H. Allie
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Signature
February 2, 2004
Date of Signature

TRANSMITTAL OF CERTIFIED COPY OF PRIORITY DOCUMENT

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Please find enclosed a certified copy of the United Kingdom Patent Application No. 0224726.0, which the present application claims priority to. It is believed that no fees are due for the submission of this priority document. However, if any fees are due, the Commissioner is authorized to charge Deposit Account No. 23-3030, but not to include any payment of issue fees.

Respectfully submitted,

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The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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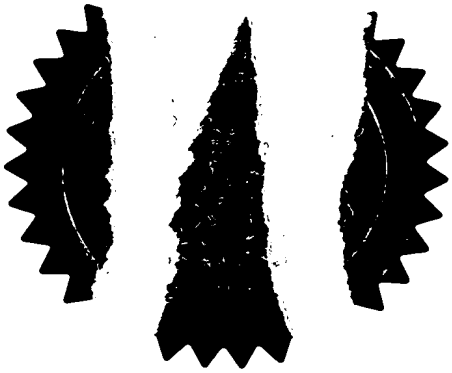

Signed

Dated 23 September 2003

Patents Form 1/77

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The Patent Office

1/77

24OCT02 E758171-8 D00354
P01/7700 0.00-0224726.0

THE PATENT OFFICE
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24 OCT 2002
NEWPORT

Request for grant of a patent

(see the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1.	Your reference	MH/M089231PGB
2.	Patent application number *(The Patent Office will fill in this part)*	0224726.0
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	HOLSET ENGINEERING COMPANY LTD ST ANDREWS ROAD HUDDERSFIELD WEST YORKSHIRE HD1 6RA
	Patents ADP number *(if you know it)*	5015770005
	If the applicant is a corporate body, give the country/state of its incorporation	UNITED KINGDOM
4.	Title of the invention	COMPRESSOR WHEEL ASSEMBLY
5.	Name of your agent *(if you have one)*	Marks & Clerk
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	Sussex House 83-85 Mosley Street Manchester M2 3LG
	Patents ADP number *(if you know it)*	18004 ✓

6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country	Priority application number *(if you know it)*	Date of filing *(day/month/year)*

7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing *(day/month/year)*

8.	Is a statement of Inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:* *a) any applicant named in part 3 is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body.* *See note (d))*	YES

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9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	-
Description	5
Claim(s)	2
Abstract	1
Drawing(s)	2

9 2

10. If you are also filing any of the following, state how many against each item.

Priority documents	
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Statement of Inventorship and right to grant of a patent *(Patents Form 7/77)*	/
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(Please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature..... Date 23 October 2002

MARKS & CLERK

12. Name and daytime telephone number of person to contact in the United Kingdom — MATTHEW HOLMES – 0161 233 5830

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Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.

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DUPLICATE

COMPRESSOR WHEEL ASSEMBLY

This invention relates to the assembly of a compressor wheel to a rotating shaft. In particular, the invention relates to the compressor wheel assembly of a turbocharger.

Turbochargers are well known devices for supplying air to the intake of an internal combustion engine at pressures above atmospheric (boost pressures). A conventional turbocharger essentially comprises an exhaust gas driven turbine wheel mounted on a rotatable shaft within a turbine housing. Rotation of the turbine wheel rotates a compressor wheel mounted on the other end of the shaft within a compressor housing. The compressor wheel delivers compressed air to the intake manifold of the engine, thereby increasing engine power. The shaft is supported on journal and thrust bearings located within a central bearing housing connected between the turbine and compressor wheel housings.

A conventional compressor wheel comprises an array of blades extending from a central hub provided with a bore for receiving one end of the turbocharger shaft. The compressor wheel is secured to the shaft by a nut which threads onto the end of the shaft where it extends through the wheel bore, and bears against the nose end of the wheel to clamp the wheel against a shaft shoulder (or other radially extending abutment that rotates with the shaft).

Modern demands on turbocharger performance require increased airflow from a turbocharger of a given size, leading to increased rotational speeds, for instance in excess of 100,000 rpm. To accommodate such high rotational speeds the turbocharger bearings, and thus the turbocharger shaft diameter, must be minimized. However, the use of a relatively small diameter shaft is problematical with the conventional compressor wheel mounting assembly. That is, it can be difficult to machine a sufficiently narrow bore through the compressor wheel to the required degree of accuracy (the bore must be concentric about the axis and rotation of the wheel if the wheel is to be rotationally balanced). As the diameter of the bore reduces there is a corresponding reduction in the size, and therefore strength, of the tool required to machine the bore. Even where the required accuracy is achievable,

Figure 2 illustrates a compressor wheel assembly in accordance with the present invention. Details of the shaft 8, thrust bearing and seal assembly 18, and clamp nut 17 may be entirely conventional, as for instance illustrated in Figure 1. With the arrangement of Figure 2 a washer 20 is located between the nut 17 and the compressor wheel, but this is also entirely conventional.

Where the present invention differs significantly from the prior art assembly of Figure 1, is that the bore through the compressor wheel is radially stepped so that it has two different diameter axial portions 21 and 22. The first axial portion 21 has a relatively small diameter corresponding to the outer diameter of the shaft 8. However the second axial portion 22 has an enlarged diameter so that its inner surface is radially spaced from the shaft 8. The compressor wheel is thus supported on the shaft 8 along the length of the first portion 21 of the bore only. The enlarged portion of the bore 22, is formed in the nose region of the wheel where wheel stresses are lower and thus does not adversely effect operation of the wheel.

Thus, in accordance with the present invention a relatively small diameter bore, of a diameter required to match the shaft 8, is machined in to the compressor wheel to a maximum length which is shorter than the axial length of the wheel at its axis, but which can be readily machined with the required accuracy. The through bore is then completed by machining the enlarged diameter second portion in the nose region of the wheel. Problems encountered in the prior art with attempts to machine a relatively small diameter bore through the full width of the compressor wheel are thus overcome.

It will be appreciated that the enlarged diameter portion 22 of the bore may be machined before or after the small diameter portion 21. Similarly, a small diameter bore could be machined right through the wheel and then enlarged over a portion of its length.

It will be appreciated that modifications may be made to the detail of the embodiment of the invention described above and illustrated in Figure 2. For instance, the relative lengths of the first and second portions of the bore may differ from that illustrated. Also, the bore need not be abruptly stepped in diameter but

could have a region of gradually increasing diameter between the first and second portions.

As a further modification a cylindrical sleeve may be fitted in to the relatively large diameter portion of the through bore, the sleeve having an inner diameter matching the diameter of the wheel to provide further support for the wheel on the shaft.

Other possible modifications will be readily apparent to the skilled person.

CLAIMS

1. A compressor wheel assembly comprising a compressor wheel mounted to a rotating shaft, the shaft extending through a bore provided along the rotational axis of the wheel, wherein the bore has a first axial portion corresponding in diameter to the diameter of the shaft, and a second axial portion of enlarged diameter, such that the inner surface of the second portion of the bore is radially spaced from the shaft.

2. A compressor wheel assembly according to claim 1, wherein an internal radial shoulder is defined between said first and second axial portions of the bore.

3. A compressor wheel assembly according to claim 1, wherein there is a gradual increase in bore diameter between said first and second axial portions of the bore.

4. A compressor wheel assembly according to any preceding claim, wherein said first axial portion of the bore extends from one axial end surface of the compressor wheel.

5. A compressor wheel assembly according to any preceding claim, wherein a cylindrical sleeve is located around said shaft extending radially between the inner surface of the second portion of the bore and the outer surface of the shaft.

6. A compressor wheel for mounting to a rotating shaft of predetermined diameter, the compressor wheel being provided with an axial through bore for receiving an end of said shaft, wherein the through bore has a first axial portion corresponding in diameter to said predetermined diameter of the shaft, and a second axial portion of greater diameter than said predetermined diameter of the shaft.

7. A compressor wheel according to claim 6, wherein a cylindrical sleeve is fitted within the second portion of the bore, the sleeve having an internal diameter corresponding to the diameter of the first portion of the bore.

8. A turbocharger comprising a turbine wheel mounted to one end of a shaft for rotation within a turbine housing, and a compressor wheel mounted to the other end of the shaft for rotation within a compressor housing, the compressor wheel having an axial through bore extending between a first axial surface of the wheel and a second axial surface of the wheel, said second axial surface facing away from said turbine, wherein the bore has a first axial portion of internal diameter corresponding to the diameter of the shaft and a second axial portion of enlarged diameter, such that the inner surface of the enlarged diameter portion of the bore is radially spaced from the shaft, and wherein said first axial portion of the bore extends from said first axial end surface of the compressor wheel part way towards said second axial end surface of the wheel.

9. A compressor wheel assembly, substantially as hereinbefore described, with reference to the accompanying drawings.

10. A turbocharger, substantially as hereinbefore described, with reference to the accompanying drawings.

ABSTRACT

A compressor wheel assembly comprises a compressor wheel (7) mounted to a rotating shaft (8) which extends through a bore provided along the rotational axis of the wheel. The bore has a first axial portion (21) corresponding in diameter to the diameter of the shaft, and a second axial portion (22) of enlarged diameter, such that the inner surface of the second portion of the bore (22) is radially spaced from the shaft (8).

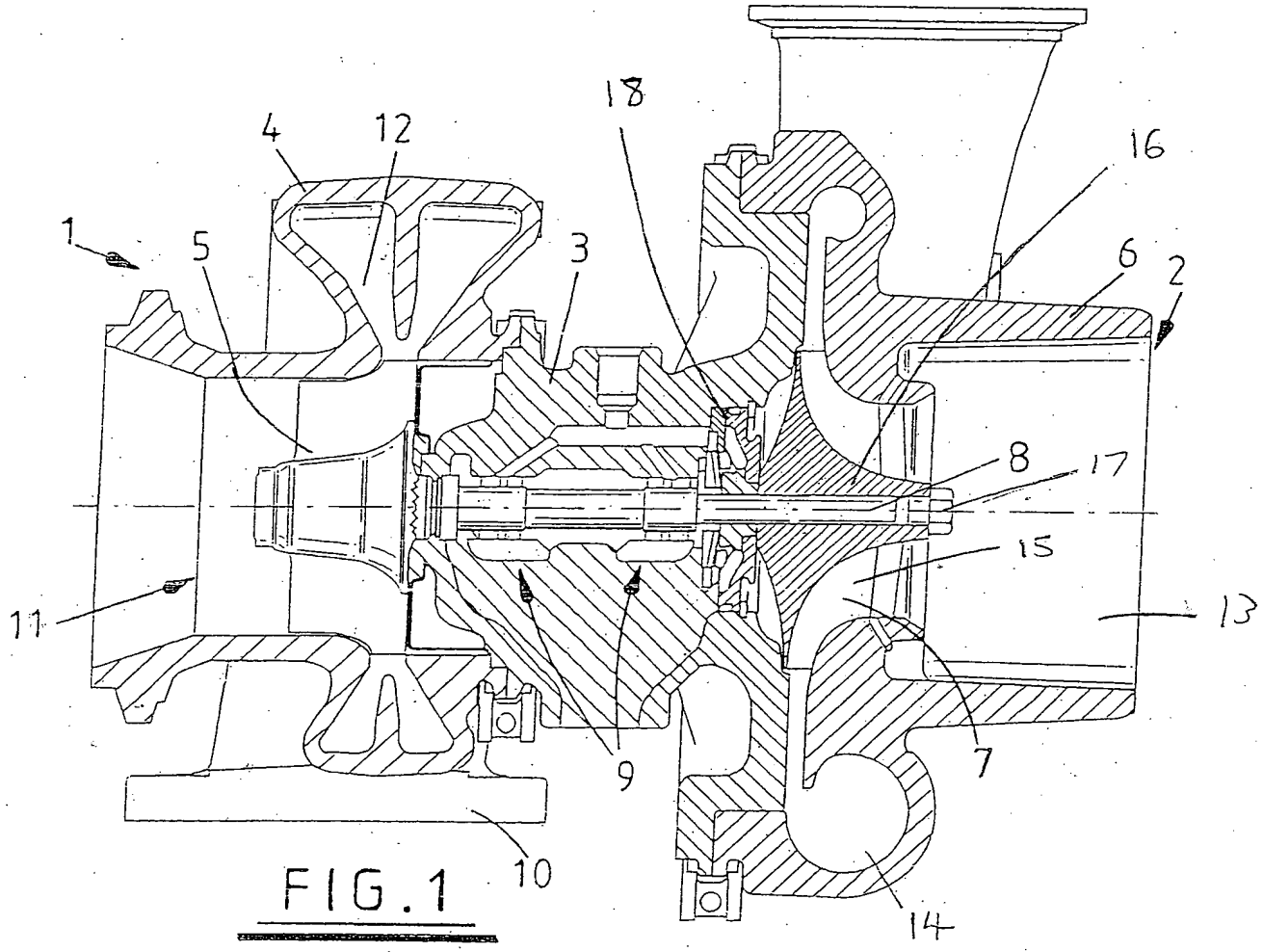

FIG. 1

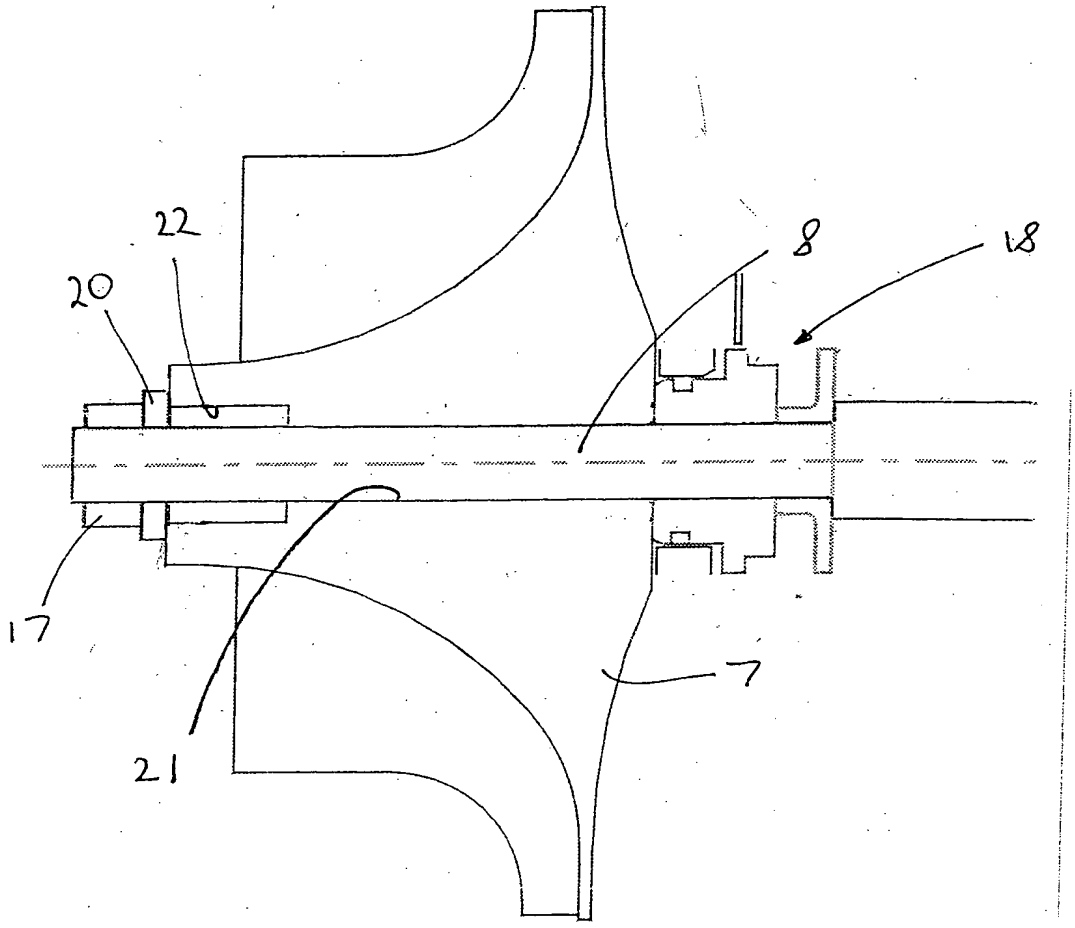

Fig 2